Grand Canyon Youth and Global Explorers "Leading the Way" Soundscape Project

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Introduction

One of the main goals of the Soundscape Program at Grand Canyon National Park is to understand the diverse acoustic environment of the park. The Colorado River is a popular destination for river runners, hikers and backpackers and little data have been collected to properly describe the acoustic zones along the river and identify data gaps.

For the second year, the Soundscape Program at Grand Canyon National Park has collaborated with Grand Canyon Youth and Global Explorers to collect valuable sound data along the Colorado River corridor. In July 2009, two groups of students collected observer logging data on the upper and lower halves of the Colorado River.
The group on the upper half of the river trip consisted of visually-impaired, blind and sighted students who collected data in pairs. The group on the lower half consisted of all sighted students who collected observer logging data individually. These trips gave the Soundscape Program a rare opportunity to have many observers collect observer logging and decibel data along the river corridor.

Methods

Observer logging is a practice where an observer listens for a designated period of time and identifies all sound sources and their durations. The students on the upper half of the river trip collected observer logging data in pairs- one sighted student and one visually-impaired or blind student per team. Each group came up with a set of hand signals for each of the sound sources so that they could silently communicate what they heard without making any noise. The sighted student would enter it into a personal digital assistant (PDA). The sighted students also entered any sound sources that they heard that their teammate did not hear. Students logged data in continuous form, recording when they started and stopped hearing each sound source. The students on the lower half of the trip worked individually and logged their data in 10-second intervals with pen and paper. Observer logging data for each session was averaged amongst all of the students to create one data set for each site. Both sets of students were trained how to conduct observer logging and had several practice sessions before starting the river trip. Both groups logged for 30 minutes at each of the sites with at least one adult logging independently. Although none of the observers had their hearing checked, it was assumed that they all had a good range of hearing based on their young age.

At each of the sites, sound pressure level data was collected during the logging session. A Larson Davis sound level meter (model 831) with a Larson Davis preamplifier (PRM831) and microphone (PCB377B20) were mounted on a tripod, approximately 1.5 meters above ground level near the loggers. This system collected second-by-second A-weighted decibel data along with the associated 33 one-third octave bands.

Based on recommendations from last year's report (Falzarano and Levy, 2008), some changes were made to the methodology. For example, observer logging sessions were increased from 15 to 30 minutes in length, session locations were expanded to include areas away from the river and river sounds, students were responsible for documenting all

sounds they heard (not just predetermined sound sources), and logging sessions occurred at different times of the day.

Results

What did we collect?: Observer logging data were collected at three sites on the upper half and at seven locations on the lower half of the river trip (Figure 1). Decibel data was only collected at seven of the ten locations. Logging sessions took place at different times of the day and at different types of locations, e.g. near the river, in side canyons and along popular inner canyon hiking trails.

What did we hear?: Natural sounds were heard at all ten logging locations at least 93% of the time, with most sites having natural sounds 99-100% of the time (Table 1). The most common natural sounds heard were flowing water, birds, and insects. Flowing water was heard at all of the sites, even at North Canyon where the river was at least ½ mile away. A small rockslide was heard at the National Camp site. Wind and animals were also heard at most of the sites.

Non-natural, or human-caused, sounds were heard at all of the sites. The site at the Little Colorado River confluence had the highest percent time audible of non-natural sounds, at 70%, most of which were helicopters. Other common non-natural sounds were high-altitude jets, propeller planes, and people. People sounds (voices and footsteps) were heard at several sites, especially those that are popular locations, e.g. Redwall Cavern and the Little Colorado River (LCR) confluence. Jets were heard 0-29% of the time. Watercraft (motorized and non-motorized) were heard at four of the sites.

Where is it quiet?: The noise free interval (NFI; the amount of time when either all natural sounds or silence was heard) was also calculated for each of the sites. The mean NFI at the sites ranged from 0.9 minutes (LCR confluence) to 34.0 minutes at 118 Mile. The longest maximum NFI also occurred at 118 Mile, 41.6 minutes, and the shortest maximum NFI occurred at the LCR confluence, 8.7 minutes.

North Canyon was the quietest location where decibel data was collected with a median sound level (L_{50}) of 32.2 dBA. Stone Creek had the highest L_{50} of 57.7 dBA. The lowest minimum sound level (L_{min}; 30.5 dBA) was also recorded at North Canyon and the highest maximum sound level (L_{max}; 78.0 dBA) was recorded at National Camp. Median sound levels at all of the locations were within 5 dBA of minimum sound levels indicating that these locations had sound levels close to minimum sound levels for the duration of the logging session (30 minutes).

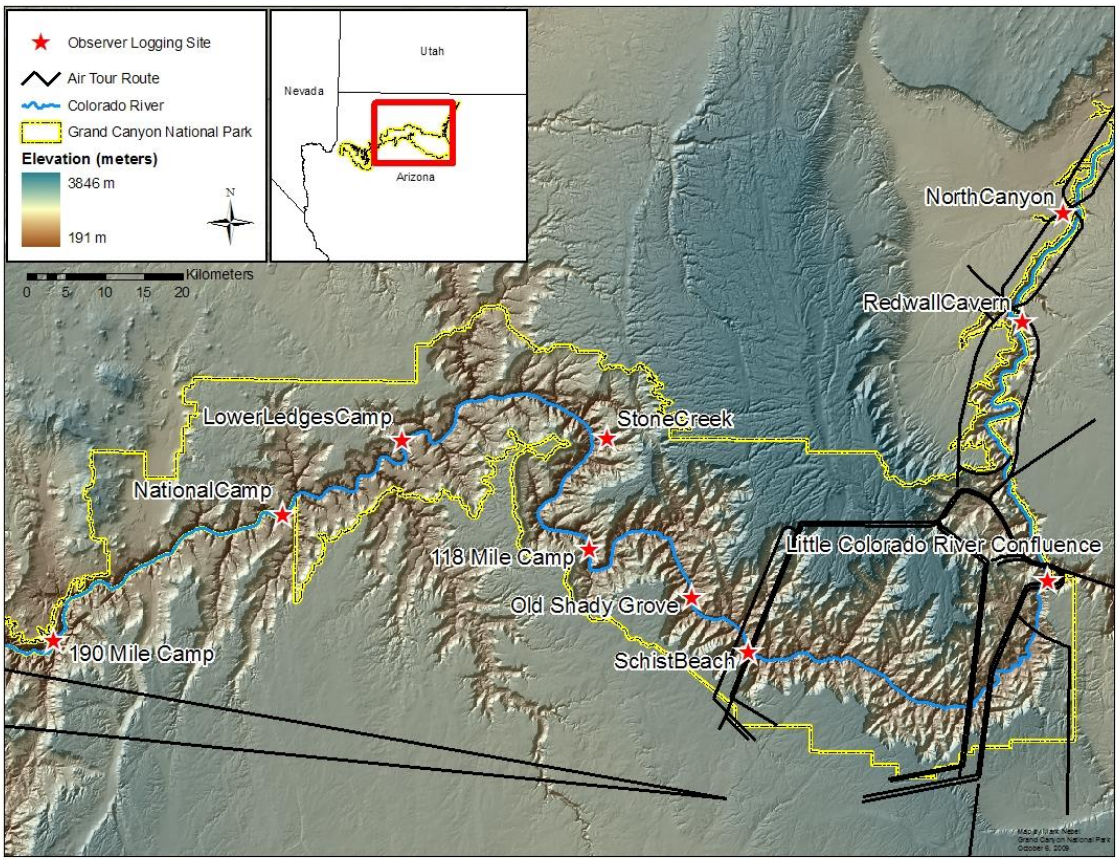

Figure 1. Map of observer logging locations in Grand Canyon National Park.

Discussion

The data collected on this trip provide important information to the Grand Canyon National Park Soundscape Program. The students were eager to participate in the project and offered useful suggestions for future trips.

Similar to the data collection in 2008 (Falzarano and Levy, 2008), jets were heard less than in previous studies. This is most likely due to the proximity of many of the sites to flowing water that masks the sound of high-altitude jets.

The data collected on this trip provide park managers with useful information about where to set-up longer term monitoring systems. The Little Colorado River confluence is a common place for river runners to stop and a sacred site for affiliated American Indian tribes associated with the canyon. It is also under a popular air tour route. Since this site had the highest percent time audible of aircraft and the shortest mean and maximum NFI, long-term acoustic monitoring is recommended.

		North Canyon	Redwall Cavern	LCR*	Schist Beach	Old Shady Grove	118 Mile	Stone Creek	Lower Ledges camp	National camp	190 Mile camp
	River mile	20.8	33.2	61.8	96.6	104	118.7	132.4	152.1	167	190.1
	Date	7/14/09	7/15/09	7/18/09	7/21/09	7/21/09	7/23/09	7/24/09	7/26/09	7/27/09	7/28/09
	Start time	15:46	13:47	10:00	07:43	13:11	07:50	10:58	18:13	16:35	17:36
	No. of loggers	11	11	11	12	13	12	10	11	10	11
Percent Time Audible for each Sound Source	Aircraft, unknown	5	7	6	7	12		12	13		
	Jet	4	3		14	11	21	22	2	29	4
	Propeller plane	6		8	7	1			15		
	Helicopter			46	18	7		14			
	Motorized raft					12				10	
	Non-motorized craft								3	4	1
	Boat wake (on shore)					2				1	
	Motor sounds					2					
	People	3	13	21	5	4			9	9	
	Non-natural, other				5	11	4	4	7		
	Non-natural, unknown	2	1		6	16	8	2	5	4	3
	Wind	34	8	10		6	1	6		30	92
	Rain									9	
	Flowing water	88	100	93	95	96	99	99	100	98	100
	Thunder				3	10				42	
	Mammal				3	1	8		3		
	Bird	19	69	12	34	3	45	5	3	13	10
	Reptile			1	2	1				1	
	Amphibian									1	3
	Insect	3	43	30	98	100	98	80	93	98	17
	Animal			18	1						1
	Rock slide									1	
	Natural, other				2	1	1				92
	Natural, unknown	18			1	4	1	1		1	1
	Unknown					1	4	4	5		5
	All aircraft	14	10	54	34	12	12	23	3	10	1
	All non-natural sources	19	21	70	37	26	14	23	16	25	2
	All natural sources	99	100	93	99	99	100	100	100	100	100
NFI (mins)	Maximum	22.6	17.9	8.7	11.8	9.5	41.6	16.3	15.5	13.9	24.1
	Mean	4.52	5.0	0.9	4.6	3.0	34.0	6.6	5.8	3.8	19.3
Sound level (dBA)	L_{50}	32.2	38.2	55.4	NA	NA	NA	57.7	42.4	54.4	52.3
	L_{min}	30.5	35.3	52.6	NA	NA	NA	57.2	39.5	52.5	46.1
	L_{max}	51.4	66.1	58.6	NA	NA	NA	60.4	57.6	78.0	74.9

Table 1. Percent time audible, noise free interval and sound level data for all ten locations. LCR = Little Colorado River. NA = Data not collected at this sit

Although logging for 30 minutes provided more information than the previous shorter logging sessions of 15 minutes, logging for a full hour would be more ideal. Some of the students commented that it was hard to concentrate for the full 30 minutes and suggested logging for less time. Unfortunately, logging for 15 minutes only provides a small "snap-shot" of sound sources that are heard in the park and is not very representative of the sounds heard throughout the day. One way to mitigate this issue would be to combine observer logging sessions with more hands on projects such as setting-up acoustic systems. This would provide more variety to the project and help keep the students feeling fresh and attentive.

Students commented that they liked using the PDAs during the observer logging sessions. This data collection method also facilitated data analysis because data did not have to be entered by hand after the trip. It is suggested though that if PDAs are used in the future, that the 10-second increment program be used (instead of continuous logging).

Students were enthusiastic about the soundscape project and it is recommended that this project continues.

Literature Cited

Falzarano, S. and Levy, L. 2008. Global Explorers "Leading the Way" Soundscape Project, Colorado River, Grand Canyon National Park. NPS Report No. GRCA-08-03. Grand Canyon National Park, AZ.

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